ARTROMOT ®-K4

Service Manual (New Generation)

Starting from Serial number 3000

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1. History

Revision	Date	Name	Change
1	21.09.2001	M. Nunnenmacher	Initial Release
2	15.10.2001	M. Nunnenmacher	Pos. 2.27 additional,1.9, 1.15, 1.16, change
3	06.11.2001	M. Nunnenmacher	Update Reference Run
4	15.01.2002	M. Nunnenmacher	Update Pos. 3.13, 3.45, 4.3, 4.5., Safetytest
5	06.02.2002	M. Nunnenmacher	Update Pos. 3.12, 7.1, 7.2
6	27.03.2002	M. Nunnenmacher	Update Pos. 1.1
7	21.10.2002	S. Herr	Update for all electronic parts, explosion drawing and reference run
8	02.06.2003	S. Herr	Update Pos. 6.0, 7.0, 2.10 explosion drawing
9	05.04.2004	S. Herr	Update Pos. 1.6, function test
10	01.08.2006	S. Herr	Update chapter 4,8, 9, Pos. 1.25 – 1.28, Pos. 4.20 – 4.26

2. Purpose

This service manual is to perform some repairs on ARTROMOT®-K4 products. Repair and maintenance work may only be carried out by authorised persons, as otherwise all warranty services and liabilities shall be void.
It is not allowed to utilize any other spare part which is not mentioned in chapter 6.

3. General

3.1 Electronic and cable

Electronic devices as hand-held programming unit, motor electronics and spiral cable are not interchangeable with ARTROMOT®-K4 serial number < 3000.

Make sure that the characteristic values of your power supply correspond to the voltage and frequency data indicated on the power adapter.

Error possibilities, showed by the hand-held programming unit:

DEVICE NEEDS
REFERENCE RUN: The reference run was interrupted or the electronics were replaced.
-> Perform a reference run. See chapter 7.4

POTENTIOMETER: Potentiometer shows incorrect value
-> Check plug connection, replace potentiometer if persistent

POTENTIOM. CABLE: Spiral cable for knee case defective
-> Replace spiral cable for knee case (Pos. 5.12), check plug connection

MOTOR DRIVER: Motor electronics defective
-> Replace motor electronics (see chapter 7.3) if persistent

OVER CURRENT: Motor power to high
-> Replace motor electronics (see chapter 7.3) if persistent

UNWANTED BUSY: Motor control unit is not answering
-> Hand-held programming unit, motor electronics or spiral cable of the hand-held programming unit defective

CPM MEMORY RAM: Memory fault in the motor control unit
-> Replace motor electronics (see chapter 7.3) if persistent

CPM MEMORY ROM: Memory fault in the motor control unit
-> Replace motor electronics (see chapter 7.3) if persistent

COMMUNICATION: Communication problem between hand-held programming unit and the motor control unit
-> Hand-held programming unit, motor electronics or spiral cable of the hand-held programming unit defective

CPM-DEVICE ERROR: General mistake in the motor control unit
-> Replace motor electronics (see chapter 7.3) if persistent

MOT. EN. TIMEOUT: Motor can not be activated
-> Check motor electronics and plug connection for motor. Replace motor electronics (see chapter 7.3) and spiral cable of the hand-held programming unit if persistent

INVALID PARAMET.: Motor control unit received a wrong parameter
-> Hand-held programming unit, motor electronics or spiral cable of the hand-held programming unit defective

STOP RELEASE ERR: Stop line can not be released
-> Remove hand-held programming unit or spiral cable (see chapter 7.2) if persistent

UNEXP. MOT. STOP: Motor stopped unexpectedly
-> Motor electronics or connecting line to motor defective

MOTOR DISABLED: Motor is disconnected
-> Motor electronics or connecting line to motor defective

MOTOR ERROR: Motor is not turning
-> Check motor cable and motor. Replace motor electronics (see chapter 7.3) if persistent

RTC INIT ERROR: Hand-held programming unit defective
-> Replace hand-held programming unit (see chapter7.2) if persistent

RTC COM ERROR: Communication problem with hand-held programming unit
-> Replace hand-held programming unit (see chapter7.2) if persistent

RTC ERROR: Hand-held programming unit defective
-> Replace hand-held programming unit (see chapter7.2) if persistent

RANGE EXCEEDED: Potentiometer shows a value out of range
-> Replace Potentiometer and/ or spiral cable

UNKNOWN CPM ERR.: Unknown error in the motor control unit
-> Replace motor electronics (see chapter 7.3) if persistent

UNDEFINED ERROR: Undefined error
-> Hand-held programming unit, motor electronics or spiral cable of the hand-held programming unit defective

CPM 24V SUPPLY: 24V supply in motor control out of range
-> Check power supply. Replace motor electronics (see chapter 7.3) if persistent

CPM 3.3V SUPPLY: 3.3V supply in motor control out of range
-> Replace motor electronics(see chapter 7.3) if persistent

HS 24V SUPPLY: 24V supply in hand-held programming out of range
-> Replace hand-held programming unit or spiral cable if persistent

HS 5V SUPPLY: 5V supply in hand-held programming unit out of range
-> Replace hand-held programming unit if persistent

HS 3.3V SUPPLY: 3.3V supply in hand-held programming unit out of range
-> Replace hand-held programming unit if persistent

3.2 Mechanics

The Threaded spindle is not interchangeable with ARTROMOT®-K4 serial number < 3000.

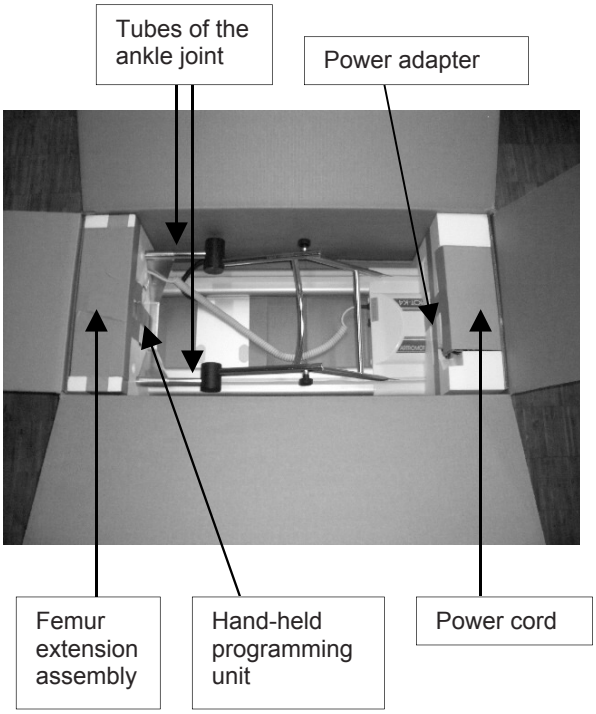
Do not loosen the knurled handles completely for any adjustment. For operation or transport, make sure that the knurled handles are tight.

3.3 Others

Do not clean the casing or the support with grease or oil.

Do not utilize any solvent for cleaning the ARTROMOT®-K4.

4. Packing and unpacking



Preparations for transport the ARTROMOT®-K4 has to be done:

The first step is to move the device in a position of EXTENSION = 5 degrees.

Switch off the device. Remove the power adapter, power cord and put it into the specified cutouts of the styrofoam.

Loosen the two knurled handles (Pos. 6.2), pull out the ankle joint (Pos. 4.x).

For transportation, use the original packaging.

Loose the knurled handle (Pos. 6.9) and turn the femur Extension around 90 degrees. Press the pushbutton (Pos. 7.4) and remove the square tube (Pos. 7.3). Put the femur extension assembly into the specified cutout of the styrofoam.

Move the two styrofoam parts on the device.

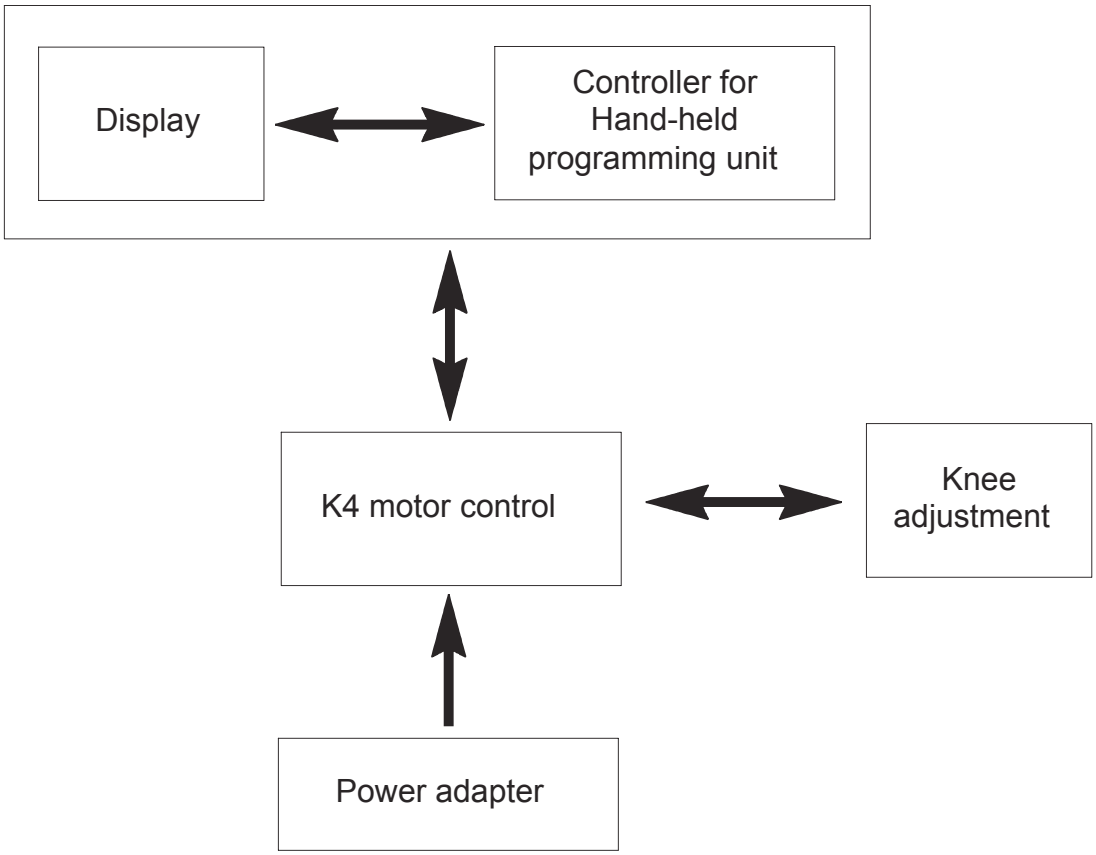
Put the hand-held programming unit into the specified cutout of the styrofoam.

Put the device with the styrofoam parts in the carton.

Move the tubes of the ankle joint upside down into the specified cutouts of the styrofoam.

Put separate pads around the foot plate and frame to protect the device against vibration and damage.

5. Block diagram of electronic parts



6. Bill of material for service parts

Position	Description	Order-Number
1.0	**Electronics**	
1.1	Power adapter 230V	0.0031.107W
	Power cord USA – version to 0.0031.107W	0.0032.011
	Power cord EU – version to 0.0031.107W	0.0032.012
1.2	Hand-held programming unit	0.0031.113
1.4	Rubber mat	2.0031.195
1.5	Sheet metal cover	2.0032.136
1.6	Motor electronics	2.0031.900RevB
1.7	Fantype lock washer	DIN6798AD3,2vz
1.8	Screw thread slab	962.903
1.9	Screw	LIKOM4x8A2
1.11	Hexagonal nut	DIN934M3vz
1.13	Cloth white	0.0010.144
1.14	Sticker	2.0013.362
1.15	Phillips screw	9B2.013
1.16	Cover top black	9B2.013
1.17	Spiral cable	2.0032.137
	Holding clip	0.0031.004
1.19	Countersunk screw	DIN7991M3x10sw
1.20	Flat connector	0.0013.125
1.21	Washer	DIN125D3,2vz
1.22	Wire-Set Motor	2.0032.139
1.23	Pan head screw	DIN912M3x6A2
1.24	Washer	2.0013.317
1.25 – 1.28	Holder set motor plate (Pos. 1.25 – 1.28)	0.0032.010
2.0	**Exterior underframe**	
2.1	Right profile	2.0031.107
2.2	Left profile	2.0031.106
2.3	Right rubber mat	2.0031.185
2.4	Right rubber mat	2.0031.187
2.5	Lip	2.0031.193
2.6	Interior slit	2.0031.167
2.7	Interior slit	2.0031.196
2.8	Right cover	2.0031.111
2.9	Left cover	2.0031.110
2.10	Shaft bearing	2.0031.112
2.11	DU collar	0.0031.110
2.12	Interior slit	2.0031.197
2.14	Exterior slit	2.0031.168
2.15	Exterior slit	2.0031.168
2.16	Connection plate	2.0031.174

2.17	Tread plate M6	962.901
2.18	Pan head screw	DIN912M6x8A2
2.19	Left rubber mat	2.0031.169
2.20	Left rubber mat	2.0031.186
2.21	Countersunk screw	2.0031.166
2.22	Countersunk screw	DIN7991M4x8A2
2.23	Spring wire	0.0031.300
2.24	Band white	2.0020.163
2.25	Inplementation spout	0.0031.145
2.27	Locking pin	DIN1481D3x12
3.0	**Drive technology**	
3.1	Motor including transmission	0.0031.100
3.2	Right slide	2.0031.108
3.3	Left slide	2.0031.109
3.4	Threaded spindle	2.0031.212
3.5	Rubber ring	2.0031.176
3.7	Rubber plate	2.0028.170
3.8	Motor plate	2.0031.156
3.9	Spline shaft drive	2.0031.181
3.10	Toothed belt	0.0031.130
3.11	Toothed lock washer drive	2.0031.180
3.12	Labeled Casing	2.0031.032
3.13	Bearing plate left	2.0031.165
3.14	Rubber plate	2.0031.102
3.15	Sheet metal	2.0031.115
3.17	Ball bearing	910.008
3.18	Rubber ring	2.0031.105
3.19	Rubber disk	2.0031.104
3.20	Joint plate	2.0031.113
3.22	Covering plate	0.0028.105
3.23	Ring	0.0028.106
3.24	Split rivet	0.0031.136
3.25	Wire-set power supply	2.0032.140
3.26	Retaining ring	DIN471A8x0,8
3.27	Rubber buffer	0.0031.109
3.28	Spacer sleeve	0.0031.104
3.29	Pin	2.0031.188
3.30	Countersunk screw	DIN7991M5x20vz
3.31	Screw thread pin	DIN916M4x4sw
3.32	Screw thread pin	DIN914M4x4sw
3.33	Countersunk screw	DIN7991M4x10vz
3.34	Hexagonal nut	DIN934M5vz
3.35	Pan head crew	DIN912M5x6vz
3.36	Countersunk screw	DIN7991M5x25A2
3.37	Countersunk screw	DIN7991M5x55vz
3.38	Countersunk screw	DIN7991M5x16vz

3.39	Bearing plate right	2.0031.103
3.50	Countersunk screw	DIN7991M4x16vz
3.51	Pan head screw	DIN912M4x12vz
3.53	Spindle nut	2.0032.141
4.0	**Ankle joint**	
4.1	Ankle joint bowl	2.0031.120
4.2	Base plate	2.0031.170
4.3	Knurled handle	GN534-40-M6-10sw
4.4	Washer	DIN9021D6,4vz
4.5	Washer	0.0031.111
4.6	Washer	0.0031.142
4.7	Screw rosette	0.0031.137
4.8	Spacer sleeve	0.0013.104
4.9	Sleeve nut	2.0031.178
4.10	Fastening band	0.0031.144
4.11	Rigid pipe	2.0031.117
4.12	Knurled handle	2.0031.031
4.13	Washer	DIN7349D6,4vz
4.14	Hinge box	2.0031.119
4.15	Washer	2.0031.118
4.16	Countersunk screw	DIN7991M5x8A2
4.17	Cylinder pin	DIN7D4x20A2
4.18	Nut	0.0031.108
4.19	Nut	0.0031.105
	New Ankle joint complete	2.0037.022K3K4
4.20	Supporting disk	2.0031.213
4.21	Ankle joint bow	2.0037.163
4.22	Base plate	2.0037.168
4.23	Countersunk screw	DIN7991M5x12A2
4.24	Ankle joint nut	2.0037.165
4.25	Distance disk	0.0037.027
4.26	Wing Screw	GN531-32-M6-10sw
4.28	Pin	DIN6325D4x12
5.0	**Knee case**	
5.1	Cover knee case	2.0031.160
5.2	Retaining ring	DIN471A10x1
5.3	Bearing shell	2.0031.146
5.4	Right knee case	2.0031.152
5.5	Left knee case	2.0031.149
5.6	Shim	DIN988D10x16x0,3
5.7	Catch	2.0031.150
5.8	Shaft	2.0031.147
5.9	Left knee case	2.0031.148
5.10	Cover knee case left	2.0031.189
5.11	Knee electronics	0.0031.121

5.12	Spiral cable for knee case	0.0031.122
5.13	Tapping screw countersunk	DIN7982D3,9x13A2
5.14	Cylinder pin	DIN6325D5x40
5.15	Screw thread pin	DIN913M6x10A2
5.16	Shim	DIN988D10x16x0,1
6.0	**Femur bow**	
6.0	Femur bow + Femur extension assembly (6.4-6.22 + 7.1-7.8)	2.0031.003
6.1	Frame (shank)	2.0031.027
6.2	Knurled handle	GN534-32-M6-10
6.3	Frame (thigh)	2.0031.028
6.4	Tube end plug	2.0031.023
6.5	Retaining ring	DIN472I20x1
6.6	CB-Disc spring	0.0028.109
6.7	Compression spring	2.0031.179
6.8	Bolt / Bolzen	2.0031.127
6.9	Knurled handle	2.0031.135
6.10	Rigid pipe	2.0031.145
6.11	Cover	2.0031.153
6.12	Case	2.0031.162
6.13	Sliding disk	2.0031.173
6.14	Joint pipe	2.0031.026
6.15	Cover	2.0031.154
6.16	Screw	DIN923M5x3vz
6.17	Flat head screw	DIN921M3x5A2
6.18	Screw thread in	DIN914M5x6A2
6.19	Edge-protection profile	2.0031.202
6.20	Sticker (lock insert)	0.0031.153
6.21	Sticker (insert)	0.0031.152
6.22	Screw thread pin	DIN915M5x10A2
6.23	Sticker (PRECAUTION)	0.0031.146
7.0	**Femur extension**	
7.0	Femur extension assembly (7.1-7.8)	2.0031.051
7.1	Leaf Spring	2.0031.143
7.2	Stud bolt	2.0031.142
7.3	Square tube	2.0031.025
7.4	Push-button	2.0031.141
7.5	Dwell bolt	GN617-5-A-NI
7.6	Countersunk screw	DIN7991M4x8A2
7.7	Hexagonal nut	DIN985M4vz
7.8	Nut	0.0031.106
Patient kits		
No illustration	Patient kit fleece	2.0032.155
No illustration	Patient kit cool-quilt	2.0032.155B
No illustration	Foot rest reconstruction K3 + K4	2.0032.012
No illustration	Leg supports reconstruction kit K3 + K4	2.0032.013
No illustration	Stereo jack connector	0.0032.200

7. How to perform the repair

7.1 How to remove the casing (Pos. 3.12)

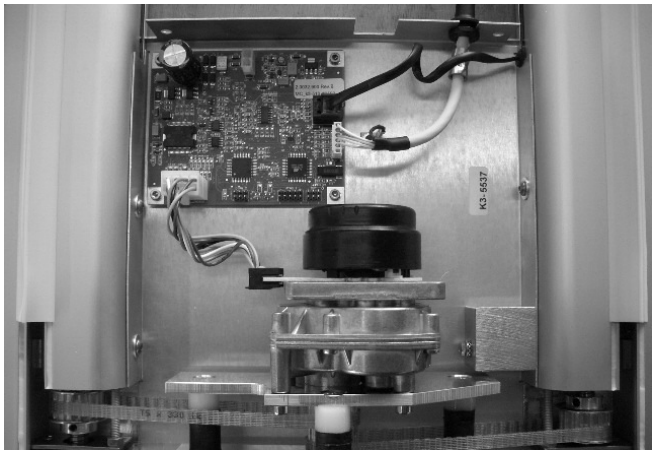
Move the ARTROMOT®-K4 in a position of approximately 120 degrees.
Turn the power OFF at the ARTROMOT®-K4 and remove the power adapter.
Hit the 4 pins of the split rivet (Pos. 3.24) inwards.
Remove the 2 covering plates (Pos. 3.22)
Loosen the 2 countersunk screws (Pos. 3.50) and remove the casing.
Remove the 4 pins of the split rivet, which are inside the casing.
If you have exchanged any of the printed circuit boards including the knee electronics and the hand held programming unit or any parts of the drive technology (Pos. 3.x), you have to perform a reference run. See chapter 7.4
Finally, a function- and safetytest has to be performed.

7.2 How to exchange the hand-held programming unit (Pos. 1.2)

Remove the casing. See chapter 7.1
Pull out the connector of the hand held programming unit.
Attention: Use your ESD (Electro Static Discharge)-equipment.
Put in the connector of the new hand held programming unit.
Rebuild the casing.
Perform a reference run. See chapter 7.4
Finally, a function- and safetytest has to be performed.

7.3 How to exchange the motor electronics (Pos. 1.6)

Remove the casing. See chapter 7.1
Pull out the required cables at the printed circuit board (Pos. 1.6)
Attention: Use your ESD (Electro Static Discharge)-equipment.
Exchange the defect printed circuit board.



Put in the cables at the same position. (Pay attention to the code)
Rebuild the casing.
Perform a reference run. See chapter 7.4
Finally, a function- and safetytest has to be performed.

7.4 How to perform a reference run.

Adjust a maximum femur length, a minimum lower leg length, hip axis in smallest position and the middle position of the foot rotation.

Under special functions select the operation REFERENCE RUN by using „+“ and „-“. Press „SET“ for five seconds.

The display shows: REFERENCE RUN (flashing for 5 sec.)
FOR SERVICE ONLY

Then the display shows: REFERENCE RUN
ENTER KEY

To start the reference run press „+“ and „-“ at the same time. While the reference run is in progress the display shows: PERFORMING R-RUN
PLEASE WAIT

The reference run starts automatically and will take up to 10 minutes. The ARTROMOT®-K4 will reach both points of the mechanical stud (first minimum at EXTENSION afterwards maximum at FLEXION).
Now the ARTROMOT®-K4 moves between -5 to 125 degrees or parts of this range with different speed and will stop at a position of 0 degrees. After the ARTROMOT®-K4 stops the display will show: REFERENCE RUN
SUCCESSFUL

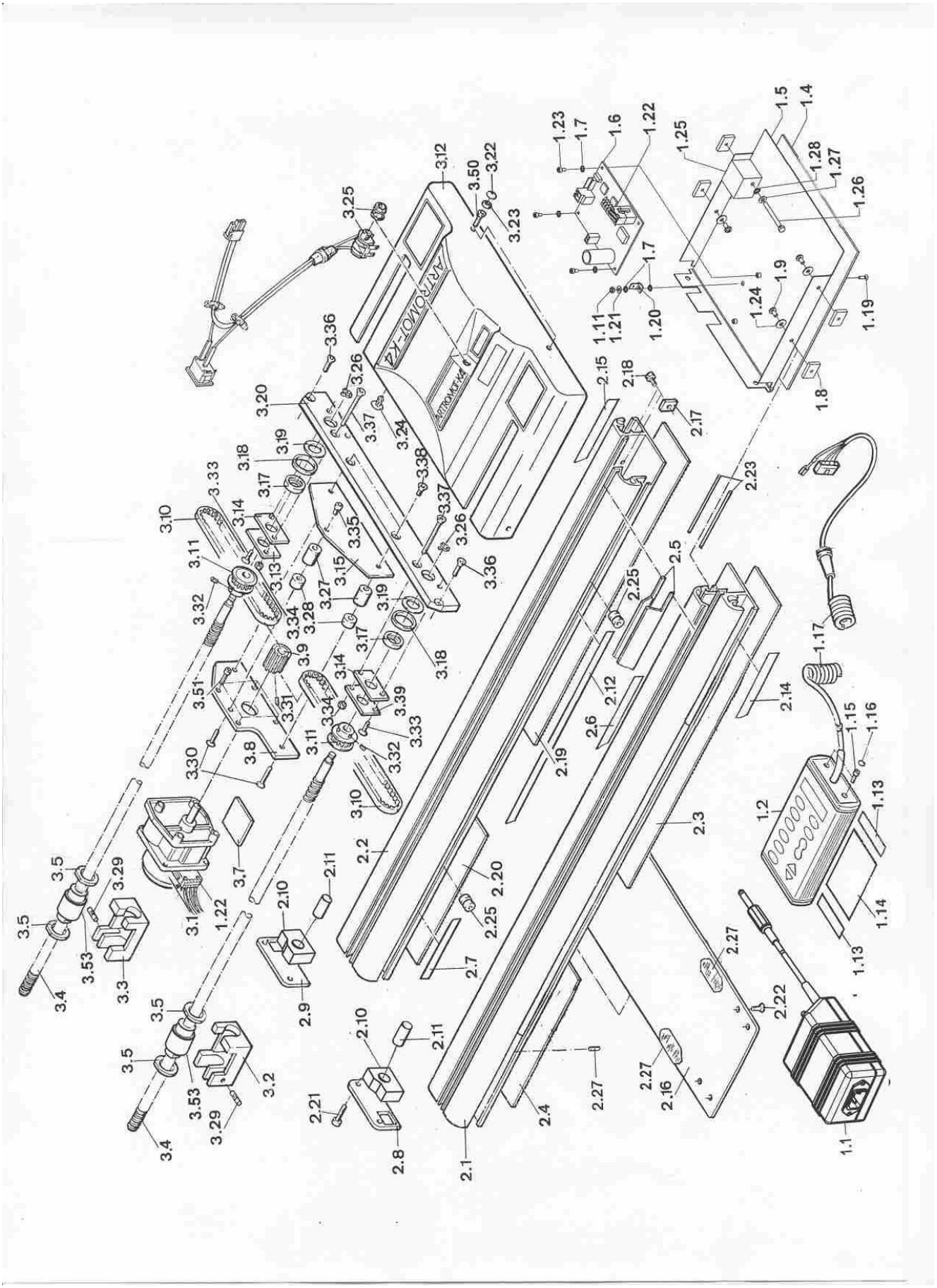
The ARTROMOT®-K4 is now ready for operation.
Finally, a function- and safetytest has to be performed.

Attention:
If the reference run was interrupted the display shows:
REFERENCE RUN
INTERRUPTED (The ARTROMOT®-K4 stops)

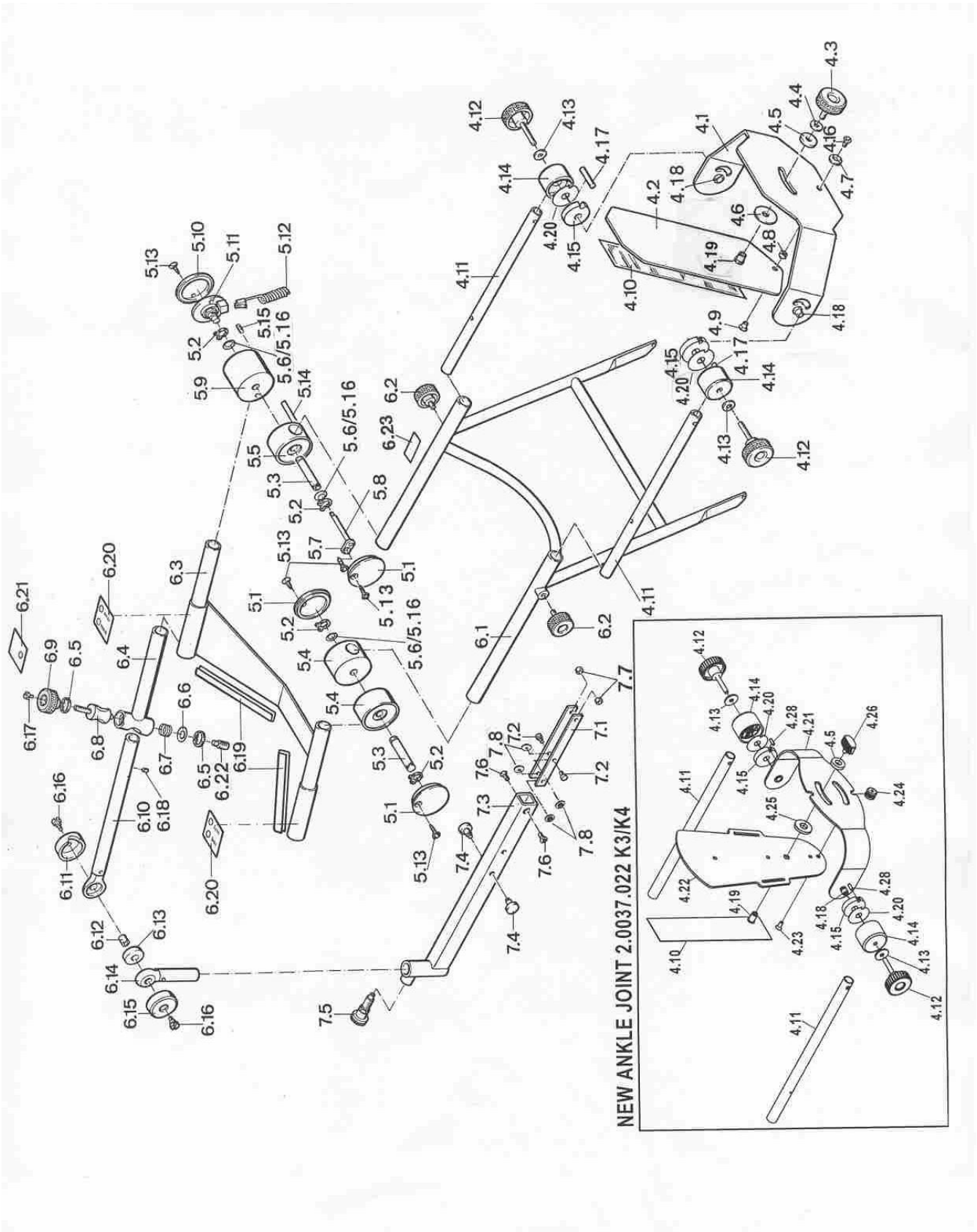
If you try to start the ARTROMOT®-K4 the display will show:
DEVICE NEEDS
REFERENCE RUN(The ARTROMOT®-K4 is inoperable)

Performe a reference run.

8. Explosion drawing part 1



9. Explosion drawing part 2



10. Checklist for safety- and function test

Safetytest			Measuring	Date/Signature
Enclosure Leakage Current	EN60601-1/VDE 0751	≤ 100 µA	µA	
Or Enclosure Leakage Current	UL2601 (115 Volt)	≤ 100 µA	µA	

Functiontest	OK	Error
1. Turn the power ON at the ARTROMOT®-K4 and press "SET". → Display: Software Version K4 V40 161002		
2. The set range of motion for Extension/Flexion is from -10 to 125 degrees. → Verify the angle in a position of -5 degrees with a tolerance of +/- 5 degrees. → Verify the angle in a position of 60 degrees with a tolerance of +/- 5 degrees. → Verify the angle in a position of 120 degrees with a tolerance of +/- 5 degrees.		
3. Safety - OFF Functions. Start the ARTROMOT®-K4 in a continuos mode. → Press any of the buttons to stop the motor immediately. Verify this for all buttons.		
4. Perform the following settings. Extension: → -10 degrees Flexion: → 125 degrees Pause Ex.: → 5 sec. Pause Flex.: → 10 sec. Force: → 45 kp Speed: → 100% Adjust a maximum femur length.		
5. First press "STOP" and afterwards press "START". → The ARTROMOT®-K4 should then reach both points of changing direction within 80 to 95 seconds.		
6. Change the speed to 50% and afterwards press "START". → The ARTROMOT®-K4 should then reach both points of changing direction within 125 to 145 seconds.		
7. Verify the settings for "Pause Ex." and "Pause Flex." → The tolerance for both is +/- 3 seconds.		

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